
Three New Species of *Paepalanthus* sect. *Diphyomene* (Eriocaulaceae) from Minas Gerais, Brazil

Marcelo Trovó,^{1,2} Lívia Echternacht,^{1,3} and Paulo Takeo Sano¹

¹Departamento de Botânica, Instituto de Biociências, Universidade de São Paulo, Rua do Matão 277, Cidade Universitária, CEP 05508-900, São Paulo, Brazil. martrovo@gmail.com; livia.echter@gmail.com; ptsano@usp.br

² Current address: Departamento de Botânica, Instituto de Biologia, Universidade Federal do Rio de Janeiro, Av. Carlos Chagas Filho 373, CEP 21941-590, Rio de Janeiro, Brazil

³ UMR 7207 CNRS MNHN UPMC, Centre de Recherche en Paléobiodiversité et Paléoenvironnements, Muséum National d’Histoire Naturelle, 75005, Paris, France

ABSTRACT. Three new species of *Paepalanthus* Mart. sect. *Diphyomene* Ruhland (Eriocaulaceae) from Minas Gerais (Brazil) are described and illustrated. *Paepalanthus arcuatus* Trovó, defined by its curved leaves, is known only from the Serra do Cipó National Park and shares morphological characters with *P. decussus* Körn. *Paepalanthus linearis* Trovó, defined by its linear leaves, is known exclusively from Itacambira and resembles *P. polycladus* Silveira. *Paepalanthus sericiscapus* Trovó, defined by its sericeous scapes, is known only from the type specimens collected in the Serra da Canastra and resembles *P. arcuatus*. All the species are known only from their type localities and are assigned a preliminary conservation status of Critically Endangered. Morphological variation, habitat, geographic distribution, and conservation status are noted.

Key words: Brazil, cerrado, Eriocaulaceae, IUCN Red List, Minas Gerais, *Paepalanthus*.

Paepalanthus Mart. sect. *Diphyomene* Ruhland comprises 15 species distributed throughout South America. This section is characterized by its unique inflorescence arranged in a tribotryum umbel-shaped structure, pistillate flowers with dolabriform sepals, and completely reduced staminodes (Trovó, 2010; Trovó et al., 2010; Trovó & Sano, 2010, 2011). In contrast to most Eriocaulaceae groups, the primary center of species diversity in *Paepalanthus* sect. *Diphyomene* is concentrated in open savannas of the Brazilian cerrados, especially in the state of Goiás (Giulietti & Hensold, 1990; Stützel, 1998; Trovó, 2010; Trovó & Sano, 2010, 2011). A secondary center of diversity for this section is in the Espinhaço Range in Minas Gerais (Brazil), where species occur in the Campos Rupestres ecoregion. All species of *Paepalanthus* sect. *Diphyomene* are narrowly distributed and usually limited to one locality, or even to a single mountain, except for the widely distributed South American species *P. chiqui-*

tensis Herzog and *P. erectifolius* Silveira (Trovó, 2010; Trovó & Sano, 2010, 2011). As a result of fieldwork and revisionary studies of the group, we describe the following three species.

1. *Paepalanthus arcuatus* Trovó, sp. nov. TYPE: Brazil. Minas Gerais: Santana do Riacho, Parque Nacional da Serra do Cipó, “MG 010, córrego duas pontinhhas,” 22 May 2007, M. L. O. Trovó, P. T. Sano, V. L. Scatena & N. L. Menezes 400 (holotype, SPF). Figure 1.

Haec species a *Paepalantho decusso* Körn. axe reproductivo breviore (ca. 4.5 vs. 5.5–8 cm longo), foliis incurvatis, capitulis dilatis (7–8 vs. 4–6 mm diam.) atque sepalis femineis apice mucronatis differt.

Herb, 32 cm tall; rhizome present, aerial stem 1.5 cm. Leaves persistent, linear to lanceolate, incurvate, patent, 5.5–7.5 × 0.3–0.4 cm, pubescent to glabrescent, margin ciliated, apex acute. Reproductive axis erect, 4.5 cm, 0.5 cm diam., glabrous; all axis bracts with similar shape, chartaceous, linear, erect to suberect, 5–5.5 × 0.3–0.4 cm, glabrous, margin ciliated, apex acute, semi-amplexicaul. Spathes 4–5 cm, glabrous, apex acute. Scapes ca. 25, arranged in an obconic umbel, 21–27.5 cm, sparsely pilose. Capitula 7–8 mm diam., discoid, white; involucral bracts in 3 to 4 series, light brown, ovate, concave, ca. 3 mm, glabrous, margin ciliated toward the apex, apex acute to obtuse; receptacle semispherical, pubescent. Flowers dimerous, ca. 46 per capitulum, ca. 45 staminate and 1 pistillate; floral bracts linear, light brown, flat, ca. 3 mm, glabrous, margin ciliated toward the apex, apex acute; staminate flowers ca. 3 mm; pedicel ca. 0.5 mm, with long trichomes; sepals navicular, light brown to golden, ca. 3 mm, glabrous, margin ciliated toward the apex, apex acute; fleshy antophore elongated; corolla fused, hyalines, membranaceous, ca. 1 mm; stamens ca. 1 mm; pistillodes




Figure 1. *Paepalanthus arcuatus* Trovó. —A. Habit. —B. Scape detail. —C. Involucral bract abaxial surface. —D. Floral bract abaxial surface. —E. Staminate flower. —F. Staminate flower with sepals removed and opened corolla. —G. Pistillate flower (juvenile). —H. Petal of the pistillate flower. —I. Sepal of the pistillate flower. —J. Gynoecium. Drawn from the holotype M. L. O. Trovó et al. 400 (SPF).

2, papillose; pistillate flower ca. 3 mm, sessile; sepals dolabriform, light brown, ca. 3 mm, abaxially pubescent, margin ciliated toward the apex, apex mucronate; petals elliptic, light brown, ca. 2 mm, abaxially pubescent, margin ciliated toward the apex, apex rounded; gynoecium ca. 2 mm, stigmatic branches bifid, as large as the nectariferous branches, staminodes completely reduced. Fruits and seeds not seen.

Distribution and habitat. *Paepalanthus arcuatus* has been collected only in the Serra do Cipó National Park in Minas Gerais, growing in the rocky soils of campos rupestres. A single flowering individual was collected after a fire in Serra do Cipó in an area widely explored by botanists.

IUCN Red List category. According to IUCN Red List criteria (2001), *Paepalanthus arcuatus* is preliminarily considered Critically Endangered (CR B1a).

Phenology. A specimen with staminate flowers in full anthesis was collected in May. The single pistillate flower was in an early stage of development. Fruits and seeds were not observed.

Etymology. The epithet *arcuatus* refers to the curved leaves, an unusual characteristic within *Paepalanthus* sect. *Diphyomene*.

Discussion. *Paepalanthus arcuatus* is sympatric only with *P. erectifolius*. These two species are easily distinguished from each other by the overall stature, as *P. erectifolius* is usually more than 1 m high. *Paepalanthus arcuatus* is also distinguished from other species of the section by its pubescent scapes and incurvate leaves. This new species is morphologically most similar to *P. decussus* Körn. The scapes in both species are arranged in an obconic umbel, the reproductive axis bracts have a similar shape, and the scapes and trichomes are equally large. However, *P. arcuatus* differs from *P. decussus* in various ways, including a shorter and glabrous reproductive axis, incurvate leaves, longer spathes, wider capitula, and the mucronate apex of the pistillate flower sepals (Table 1). *Paepalanthus decussus* has been seen only near the town of Ouro Preto in Minas Gerais, and *P. arcuatus* is known only from Serra do Cipó National Park also in Minas Gerais; the two species are allopatric.

2. *Paepalanthus linearis* Trovó, sp. nov. TYPE:
Brazil. Minas Gerais: Itacambira “Plantar MG
15—Fazenda Tamanduá,” 10 Apr. 2005, E.

Table 1. Morphological differences between *Paepalanthus arcuatus* and *P. decussus*.

	<i>P. arcuatus</i>	<i>P. decussus</i>
Reproductive axis size (cm)	4.5	5.5–8
Leaf transversal position	incurvate	flat
Spatha size (cm)	4–5	3–4
Capitula width (cm)	0.7–0.8	0.4–0.6
Apex of sepal in the pistillate flowers	mucronate	obtuse

Tameirão Neto 4216 (holotype, SPF; isotype, BHCB). Figure 2.

Haec species a *Paepalantho arcuato* Trovó foliis planis brevioribus (1.5–2 vs. 5.5–7.5 cm longis), axis reproductivi bracteis lanceolatis brevioribus (2.5–3.5 vs. 5–5.5 cm longis), scapis sericeis brevioribus (13.5–15 vs. 21–27.5 cm longis) atque floribus femineis pedicellatis differt.

Herb, 51–60 cm tall; rhizome present, aerial stem 0.5–1.5 cm. Leaves deciduous, linear, flat, semi-erect, 3.5–13 × 0.1–0.2 cm, pubescent to glabrescent, margin ciliated, apex acute. Reproductive axis erect, 31–40 cm, 0.4 cm diam., glabrous; all axis bracts with same shape, chartaceous, linear to lanceolate, erect to suberect, 2–4 × 0.2–0.4 cm, glabrous, margin glabrous, apex acute, semi-amplexicaul. Spathes 2–3.5 cm, glabrous, apex acute. Scapes 25 to 53, arranged in a semispherical umbel, 21–25.5 cm, pubescent toward the apex. Capitula 6–8 mm diam., semispherical, white; involucral bracts in 4 to 5 series, brown, ovate, concave, ca. 3 mm, glabrous, margin ciliated toward the apex, apex acute; receptacle semispherical, pubescent. Flowers dimerous, ca. 320 per capitulum, ca. 240 staminate and 80 pistillate; floral bracts linear, light brown, flat, ca. 3 mm, abaxially pubescent, margin ciliated toward the apex, apex acute; staminate flowers ca. 3 mm; pedicel ca. 0.5 mm, with long trichomes; sepals navicular, light brown to golden, ca. 3 mm, abaxially pubescent, margin ciliated toward the apex, apex acute; fleshy antophore elongated; corolla fused, hyalines, membranaceous, ca. 1 mm long; stamens ca. 1 mm; pistillodes 2, papillose; pistillate flowers ca. 3 mm, sessile, disposed in concentric rings; sepals dolabriiform, light brown to gold, ca. 3 mm, abaxially pubescent, margin ciliated toward the apex, apex mucronate; petals elliptic, light brown to golden, ca. 2 mm, abaxially pubescent, margin ciliated toward the apex, apex rounded; gynoecium ca. 2 mm, stigmatic branches bifid, same size as the nectariferous branches, staminodes completely reduced. Fruit a loculicidal capsule. Seeds ca. 1 mm, reticulate surface, red to brownish.




Figure 2. *Paepalanthus linearis* Trovó. —A. Habit. —B. Leaf detail. —C. Involucral bract abaxial surface. —D. Floral bract abaxial surface. —E. Staminate flower. —F. Staminate flower with sepals removed and opened corolla. —G. Sepal of the staminate flower. —H. Pistillate flower. —I. Sepal of the pistillate flower. —J. Gynoecium. Drawn from the holotype E. Tameirão Neto 4216 (SPF).

Distribution and habitat. *Paepalanthus linearis* is restricted to a single locality in the mountains to the north of the Espinhaço Range near Itacambira in Minas Gerais. The two collections came from the same population in grass-dominated open savanna.

IUCN Red List category. According to IUCN Red List criteria (2001), *Paepalanthus linearis* is preliminarily considered Critically Endangered (CR B1ab+B2a).

Phenology. Individuals with staminate and pistillate flowers in full anthesis were collected in April. Fruits were collected in October.

Etymology. The epithet *linearis* refers to the linear leaves, which are usually deciduous in mature individuals.

Discussion. *Paepalanthus linearis* is the only species of the section that is known to occur in the northern portion of the Espinhaço Range in Minas Gerais. It can be distinguished from the other species of *Paepalanthus* sect. *Diphyomene* by its unusual semi-erect and linear leaves. In *P. amoenus* (Bong.) Körn., another species from Minas Gerais, the leaves are also linear, but in comparison with those of the new species are smaller and patent. These species are allopatric, as *P. amoenus* is confined to the south of the Espinhaço Range.

Paepalanthus linearis and *P. polycladus* are morphologically very similar. The reproductive axis and scapes of both are the same approximate size, and both have deciduous leaves. *Paepalanthus linearis* is distinguished from the latter species by its semi-erect and linear leaves, relatively smaller size of spathes and capitula (Table 2), and characters from the pistillate flowers, including sepals with mucronate apex, petals abaxially pubescent, and stigmatic branches the same size as the nectariferous branches. Moreover, the species are allopatric, as *P. polycladus* is endemic to the Serra da Canastra National Park.

Paratype. BRAZIL Minas Gerais: Itacambira, Plantar “MG 15—Fazenda Tamanduá,” 9 Oct. 2005, E. Tameirão Neto 4052 (BHCB, SPF).

3. *Paepalanthus sericiscapus* Trovó, sp. nov. TYPE: Brazil. Minas Gerais: São Roque de Minas, Parque Nacional da Serra da Canastra “Chapadão do Diamante,” 16 July 1995, R. Romero, J. N. Nakajima, R. Oliveira, P. E. Oliveira & I. Schiavini 2464 (holotype, SPF; isotype, HUFU). Figure 3.

Haec species a *Paepalantho polyclado* Silveira foliis linearibus semierectis, spathis brevioribus (2–3.5 vs. 3.5–8 cm longis), capitulis angustioribus (6–8 vs. 8–12 mm diam.), sepalis feminis apice mucronatis, petalis abaxialiter pubescentibus apicem versus ciliatis atque stylo ramis stigmaticis et nectariferis aequantibus differt.

Herb, 15–20 cm tall; rhizome absent, aerial stem 0.5 cm. Leaves persistent, lanceolate, flat, patent, 1.5–2 × 0.4–0.6 cm, glabrous, margin glabrous, apex acute. Reproductive axis erect, 3.5–4 cm, 0.5 cm diam., glabrous; all axis bracts with same shape, chartaceous, lanceolate, suberect, 2.5–3.5 × 0.3–0.5 cm, glabrous, margin ciliated, apex acute, semi-amplexicaul. Spathes 2.5–3 cm, glabrous, apex acute. Scapes 11 to 17, arranged in an obconic umbel, 13.5–15 cm, sericeous. Capitula 7–9 cm diam., discoid to semispherical, white; involucral bracts in 3 to 4 series, light brown, ovate, concave, ca. 3 mm, glabrous, margin ciliated toward the apex, apex acute to obtuse; receptacle semispherical, pubescent. Flowers dimerous, ca. 180 per capitulum, ca. 150 staminate and 30 pistillate; floral bracts linear, brown, flat, ca. 2 mm, glabrous, margin ciliated toward the apex, apex acute; staminate flowers ca. 3 mm; pedicel ca. 0.5 mm, with long trichomes; sepals navicular, light brown, ca. 3 mm, glabrous, margin ciliated toward the apex, apex acute; fleshy anthophore elongated; corolla fused, hyalines, membranaceous, ca. 1 mm; stamens ca. 1 mm; pistillodes 2, papillose; pistillate flower ca. 3 mm, pedicel 3 mm; sepals dolabriform to navicular, light brown, ca. 3 mm, glabrous, margin ciliated toward the apex, apex

Table 2. Morphological differences between *Paepalanthus linearis* and *P. polycladus*.

	<i>P. linearis</i>	<i>P. polycladus</i>
Leaf form	linear	lanceolate
Leaf orientation	semierect	patent
Spatha size (cm)	2–3.5	3.5–8
Capitula size (cm)	0.6–0.8	0.8–1.2
Apex of the pistillate flower sepal	mucronate	obtuse
Trichomes of sepal of the pistillate flowers	restricted to the base	apex and center
Stigmatic branches/nectariferous branches	same size	twice longer




Figure 3. *Paepalanthus sericiscapus* Trovó. —A. Habit. —B. Scape detail. —C. Involucral bract abaxial surface. —D. Floral bract abaxial surface. —E. Staminate flower. —F. Staminate flower with sepals removed and opened corolla. —G. Pistillate flower (juvenile). —H. Sepal of the pistillate flower. —I. Petal of the pistillate flower. —J. Gynoecium. Drawn from the holotype R. Romero et al. 2464 (SPF).

Table 3. Morphological differences between *Paepalanthus sericiscapus* and *P. arcuatus*.

	<i>P. sericiscapus</i>	<i>P. arcuatus</i>
Leaf transversal position	flat	incurvate
Leaf size (cm)	1.5–2	5.5–7.5
Reproductive axis bract form	lanceolate	linear
Reproductive axis bract size (cm)	2.5–3.5	5–5.5
Scape size (cm)	13.5–15	21–27.5
Scape trichomes	sericeous	pubescent
Pedicel of the pistillate flower	present	absent

acute; petals elliptic, hyaline, ca. 1 mm, glabrous, margin ciliated toward the apex, apex rounded; gynoecium ca. 1 mm, stigmatic branches bifid, as large as the nectariferous branches, staminodes completely reduced. Fruits and seeds not seen.

Distribution and habitat. *Paepalanthus sericiscapus* is known only from the type collection in the Serra da Canastra National Park, concurring with grasses in campos rupestres.

IUCN Red List category. According to IUCN Red List criteria (2001), *Paepalanthus sericiscapus* is preliminarily considered Critically Endangered (CR B1a).

Phenology. Individuals with staminate flowers in anthesis were collected in July. The pistillate flowers were in an early stage of development. Fruits and seeds were not encountered.

Etymology. The epithet *sericiscapus* refers to the distinctive densely sericeous scapes.

Discussion. The sericeous scapes of *Paepalanthus sericiscapus* are unique among the other species in *Paepalanthus* sect. *Diphyomene*, which have glabrous scapes (except *P. decussus* and *P. arcuatus*, which have sparsely pilose scapes). The presence of pedicels and the navicular to dolabriform petals of the pistillate flower are also remarkable in this new species. *Paepalanthus sericiscapus* is sympatric with *P. polycladus* Silveira and *P. chiquitensis*, but it is distinguished from those species by its relatively shorter stature.

Paepalanthus sericiscapus is morphologically related to *P. arcuatus*. These species are two of the smallest species within the section, both not surpassing ca. 30 cm in stature. Capitula width and the obconic scape arrangement are also similar among these taxa. Apart from the pubescent scapes and the floral characteristics stated above, *P. sericiscapus* is distinguished from *P. arcuatus* by its

shorter, flat leaves and shorter, lanceolate reproductive axis bracts (Table 3).

Acknowledgments. We thank Leandro Assis and Leonardo Borges for critically reading the manuscript. We also thank Rosana Romero (HUFU) for helping with herbarium specimens. Financial support: M. T., International Association for Plant Taxonomy (IAPT) and Coordenação de Aperfeiçoamento de Pessoal em Nível Superior (CAPES); L. E., Fundação de Amparo à Pesquisa do Estado de São Paulo, proc 08/54886-1 (FAPESP), and CAPES; P. T. S., Conselho Nacional de Desenvolvimento Científico e Tecnológico, proc. 309376/2006-8 (CNPq).

Literature Cited

- Giulietti, A. M. & N. Hensold. 1990. Padrões de distribuição geográfica dos gêneros de Eriocaulaceae. *Acta Bot. Brasil.* 4(1): 133–159.
- IUCN. 2001. IUCN Red List Categories and Criteria, Version 3.1. Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland, and Cambridge, United Kingdom.
- Stützel, T. 1998. Eriocaulaceae. Pp. 197–207 in K. Kubitzki (editor), *The Families and Genera of Vascular Plants—Flowering Plants: Monocotyledons—Alismatae and Comelinanae (except Gramineae)*, Vol. 7. Springer-Verlag, Berlin.
- Trovó, M. 2010. Sistemática de Paepalanthoideae (Eriocaulaceae): Filogenia, Morfologia e Taxonomia de *Diphyomene* (Ruhland) Trovó. [Unpub.] Ph.D. Thesis, Instituto de Biociências, Universidade de São Paulo, São Paulo.
- Trovó, M. & P. T. Sano. 2010. Taxonomic survey of *Paepalanthus* sect. *Diphyomene* Ruhland (Eriocaulaceae). *Phytotaxa* 14: 49–55.
- Trovó, M. & P. T. Sano. 2011. Five new and narrowly distributed species of *Paepalanthus* sect. *Diphyomene* Ruhland (Eriocaulaceae) from central Brazil. *Syst. Bot.* 36: 610–620.
- Trovó, M., T. Stützel, V. L. Scatena & P. T. Sano. 2010. Morphology and anatomy of inflorescence and inflorescence axis in *Paepalanthus* sect. *Diphyomene* Ruhland (Eriocaulaceae, Poales) and its taxonomic implications. *Flora* 205: 242–250.

APPENDIX 1. ADDITIONAL SPECIMENS USED FOR MORPHOLOGICAL COMPARISONS.

Paepalanthus decussus Körn., BRAZIL. Minas Gerais: Ouro Preto, s.d., Claussen s.n. (BR); Mariana, 4 Apr. 2008, Messias 1963 (OUPR).

Paepalanthus polycladus Silveira, BRAZIL. Minas Gerais: São Roque de Minas, 18 Apr. 1982, Castro 306, 307 (SPF); 16 Apr. 1994, Romero et al. 844 (SPF); 18 Mar. 1995, Nakajima et al. 867, 882 (SPF); 10 May 1995, Nakajima et al. 1009 (SPF); 11 May 1995, Romero et al. 2219 (SPF); 15 July 1995, Romero et al. 2420 (SPF); 18 July 1995, Nakajima et al. 1257 (SPF); 28 Sep. 1995, Romero et al. 2995 (SPF); 19 Mar. 1998, Sano et al. 942 (SPF); 15 May 2007, Trovó & Watanabe 391 (SPF).